

ENGINEERING DESIGN FILE

EDF No.: 5786 EDF Rev. No.: 0 Project File No.: 24872 & 22901

1. Title: <u>Subsidence Evaluation for V-1, V-2, V-3 and V-14 in the ICDF Cell</u>				
2. Index Codes: TAN-607/ Building/Type <u>ICDF</u> SSC ID <u>V-14, V-Tanks</u> Site Area <u>ICDF</u>				
3. NPH Performance Category: _____ or <input checked="" type="checkbox"/> N/A				
4. EDF Safety Category: _____ or <input checked="" type="checkbox"/> N/A SCC Safety Category: _____ or <input checked="" type="checkbox"/> N/A				
5. Summary: Waste containers to be disposed at the Idaho CERCLA Disposal Facility (ICDF) must minimize settlement and subsidence of the ICDF landfill to the maximum extent possible. The PM-2A tank V-14 and the V-tanks V-1, V-2, and V-3 will be used to contain treated solidified waste and will be disposed in the ICDF landfill. This Engineering Design File describes how these four tanks and their contents will meet the intent of the ICDF subsidence requirements.				
6. Review (R) and Approval (A) and Acceptance (Ac) Signatures: (See instructions for definitions of terms and significance of signatures.)				
	R/A	Typed Name/Organization	Signature	Date
Performer/Author	N/A	Bruce Bonnema	<i>Bruce Bonnema</i>	6/21/2005
Technical Checker	R	Dave Eaton	Approved via email	6/21/2005
Independent Peer Reviewer (if applicable)	R			
Approver	A	Dave Nickelson	Approved via telecon	6/23/2005
Requestor (if applicable)	Ac	Al Yonk	Approved via email	6/21/2005
Reviewer	R	Pat Gibson	Approved via voice mail	6/21/2005
Reviewer	R	Mahlon Heilesen	Approved per telecon with Pat Gibson	6/23/2005
Doc. Control	AC	Annie Butters/1313	<i>Annie Butters</i>	6/23/05
7. Distribution: (Name and Mail Stop)				
8. Does document contain sensitive unclassified information? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, what category:				
9. Can document be externally distributed? <input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> No				
10. Uniform File Code: 8201 Disposition Authority: A17-30-C-2 Record Retention Period: 25 years after project completion				
11. For QA Records Classification Only: <input type="checkbox"/> Lifetime <input type="checkbox"/> Nonpermanent <input type="checkbox"/> Permanent Item and activity to which the QA Record apply: N/A				
12. NRC related? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No				



**Bruce E
Bonnema/BONNBE/CC01/INE
EL/US**

06/23/2005 01:24 PM

To :Deanne M Buttars/BUTTDM/CC01/INEEL/US@INEL
cc
bcc
Subject Fw: Revised EDF-5786

----- Forwarded by Bruce E Bonnema/BONNBE/CC01/INEEL/US on 06/23/2005 01:24 PM -----



**David L
Eaton/DLE/CC01/INEEL/US**

06/21/2005 04:49 PM

To Bruce E Bonnema/BONNBE/CC01/INEEL/US@INEL
cc David F Nickelson/DFN/CC01/INEEL/US@INEL
Subject Re: Revised EDF-5786 

You have my concurrence to sign per this email
Dave

David L. Eaton
INEEL WAG 1/Mixed Waste Technology/ EAP
Phone 208-526-7002
Cell 208-520-3714
Fax 208-526-2947
Email dle@inel.gov
Bruce E Bonnema/BONNBE/CC01/INEEL/US



**Bruce E
Bonnema/BONNBE/CC01/INE
EL/US**

06/21/2005 04:21 PM

To David L Eaton/DLE/CC01/INEEL/US@INEL
cc David F Nickelson/DFN/CC01/INEEL/US@INEL
Subject Re: Revised EDF-5786 

I don't know anything about the ORB system. All I want is an approval to sign for you as the checker on the EDF. Approval can be made via email for telephone. Dave Nickelson may be concerned about the ORB - I don't know.

Thanks.
David L Eaton/DLE/CC01/INEEL/US



**David L
Eaton/DLE/CC01/INEEL/US**

06/21/2005 03:30 PM

To Bruce E Bonnema/BONNBE/CC01/INEEL/US@INEL
cc
Subject Re: Revised EDF-5786 

OK, now what? ORB doesn't give me any opportunity for accepting resolutions.
Dave



**Bruce E
Bonnema/BONNBE/CC01/INE
EL/US**

06/23/2005 01:25 PM

To :Deanne M Buttars/BUTTDM/CC01/INEEL/US@INEL
cc
bcc
Subject Fw: Revised EDF-5786

----- Forwarded by Bruce E Bonnema/BONNBE/CC01/INEEL/US on 06/23/2005 01:25 PM -----



**Alan K
Yonk/YONKAK/CC01/INEEL/
US**

06/21/2005 02:18 PM

To Bruce E Bonnema/BONNBE/CC01/INEEL/US@INEL
cc
Subject Re: Fw: Revised EDF-5786

Bruce,

I have no comments on the EDF and could sign-off on it.

AI

Bruce E Bonnema/BONNBE/CC01/INEEL/US



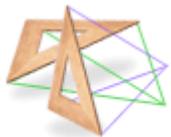
**Bruce E
Bonnema/BONNBE/CC01/INE
EL/US**

06/21/2005 01:49 PM

To Alan K Yonk/YONKAK/CC01/INEEL/US@INEL
cc
Subject Fw: Revised EDF-5786

AI, the EDF is attached at the bottom of this email. Please let me know if you have any questions/comments.

----- Forwarded by Bruce E Bonnema/BONNBE/CC01/INEEL/US on 06/21/2005 01:47 PM -----



**David L
Eaton/DLE/CC01/INEEL/US**

06/21/2005 10:27 AM

To Bruce E Bonnema/BONNBE/CC01/INEEL/US@INEL
cc
Subject Re: Revised EDF-5786

Bruce,

Doesn't look like you addressed my comments. What's up?

Dave

David L. Eaton
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431.02
01/30/2003
Rev. 11

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2. Index Codes: TAN-607/ Building/Type <u>ICDF</u> SSC ID <u>V-14, V-Tanks</u> Site Area <u>ICDF</u>
13. Registered Professional Engineer's Stamp (if required)

Background

The PM-2A tank V-14 and the V-tanks V-1, V-2, and V-3 will be disposed at the Idaho CERCLA Disposal Facility (ICDF). Waste buried at the ICDF must meet the ICDF Waste Acceptance Criteria for minimizing subsidence.¹ This criteria states:

“All waste shall be packaged in a form that minimizes settling and subsidence of the ICDF landfill to the maximum extent feasible. The following forms will be considered to meet these criteria:

- Inherently stable waste that will not subside in the disposal environment
- Waste stabilized by grouting or packaging
- Containerized soil and soil-like solids and sorbed liquids that fill at least 95% of the volume of the container
- Other containerized waste that fills at least 95% of the internal volume of the container; void space should be kept to a minimum
- Any void fillers must be selected and used in accordance with the requirements of these waste acceptance criteria.”

This Engineering Design File (EDF) documents the technical basis that explains how these four tanks and their waste contents will meet the ICDF subsidence requirements.

V-14 is a 50,000 gallon tank that is 12.5 foot diameter by 55 feet long. Its shell is made of 5/8 inch thick carbon steel coated with tar. The three V-tanks are 10,000 gallon capacity tanks that are 10 foot diameter and 18 feet long. Their shells are made of 1/2 inch thick stainless steel.

Prior to final disposition at ICDF, the waste in the V-14 tank as well as the waste from the V-tanks will be solidified with a super-absorbent polyacrylate/polyacrylamide material that will be mixed with the tank waste. The ratio of free water to super-absorbent will (nominally) be between 5 and 15 to 1. The final ratio will be determined as a result of mock up testing separately for V-14 and for the other V-Tanks. After the waste is solidified in each tank, grout will be added to each tank reducing void space to less than 5% of each tank's total volume.

V-14 solidified waste volume is expected to be approximately 12% of the tank volume. The V-tank solidified waste volume is expected to be more than 50% of the tank volume but less than 80%. Once a tank is located in the ICDF cell, grout will be placed around the bottom portion of each tank to meet compaction requirements and to avoid subsidence problems once soil backfill is placed around and above the tank. The backfill earth column (i.e. landfill cover) is projected to be as high as 30 ft above the tanks.

Assumptions

The following assumptions apply to this evaluation .

- The tank internal volumes will be backfilled with grout so their void volume is less than 5% of the total volume.
- The compressive strength of the grout is equal to or greater than that of the compacted surrounding soil.
- Grout will be placed around the bottom of each tank placed in the ICDF cell to provide compaction requirements around the base of the tanks.
- The total waste depth in the ICDF landfill is 34 feet (ft).

Evaluation of Tank V-14

Prior to waste treatment, the sludge waste volume in V-14 fills approximately 7 % of the tank. Approximately half or 4% is water. In order to adequately treat the waste, water will be added so that the final waste volume is estimated to occupy about 12% of the tank volume. Following treatment, free liquids will be eliminated by adding the polyacrylate/polyacrylamide material. Based upon visual observation, the solidification agent does not significantly increase the volume. Therefore V-14 will still be approximately 12% filled after the waste is solidified. The waste solidification process will be followed by pumping grout into the tank to fill the void space. The grouting operation will be performed once the tank is in place within the landfill due to the tank's size and associated weight after grouting. The addition of approximately 43,000 gallons of non-compressible grout (approximately 10 ft. deep) on top of approximately 6000 gallons of solidified waste (approximately 2 ft. deep) minimizes long term subsidence concerns associated with the solidified waste form.

A conservative, worst case scenario for ICDF landfill subsidence caused by V-14 is that the solidified water/sludge mixture has no compressive strength and does not mix with the grout during grouting operations, the tank shell fails and there is a 5 % void space in the tank after grouting. Under these conditions, there could be a 14 % tank volume void space (9 % from water loss and 5 % from the inability to completely fill the tank with grout). This corresponds to 950 cubic feet (ft³) of tank volume. If the void space volume is averaged over the horizontal foot print area of the tank, a vertical subsidence of 1.4 ft could occur if the tank wall fails.

The total expected subsidence for the landfill is described in EDF-ER-267². The anticipated subsidence for 34 ft of compacted soil and degradable debris is 5 ft. Another foot of subsidence was added for 55 gallon drums that may collapse over time. The total estimated subsidence for the landfill itself is 6 ft. Therefore, after adjusting the estimated subsidence of the soil and debris for the tank's diameter (12.5 ft), the total subsidence of the landfill area over V-14 is estimated to be:

$$1.4 \text{ ft} + ((34 - 12.5)/34) \times 5 \text{ ft} + 1 \text{ ft} = 5.6 \text{ ft}$$

Adding 1.3 ft for the estimated subsidence of the landfill's foundation and cover yields a total anticipated subsidence of 6.9 ft. This is well below the maximum subsidence limit that was designed into the ICDF landfill cover. The cover design allows for a total subsidence of 13 ft while maintaining the required minimum slope for surface water run-off.²

The ICDF landfill cover subsidence criteria will be met for the disposal of V-14 because of the following conditions:

1. The non-compressible nature of the tank,
2. The non-compressible nature of the tank contents primarily filled with grout,
3. The void volume at the point of disposal (after grouting) is less than 5%,
4. The supporting grout placed around the bottom of the tank eliminates soil compaction concerns around the base of the tank, and
5. Normal soil compaction requirements can be met during subsequent waste placement and compaction above tank.
6. The total predicted subsidence under the worst case scenario is 6.9 ft and is well below the maximum allowable cover settlement (13 ft).

In addition, ICDF personnel have calculated the void space for V-13, a tank identical to V-14, to be less than 1 % after it was filled with grout. If V-14 is filled within 99% capacity after grouting, then the estimated 1.4 ft landfill cover subsidence attributed to the tank and its contents decreases to 1 ft.

Evaluation of Tanks V-1, V-2, and V-3

V-Tanks V-1, V-2 and V-3 will be partially filled with treated waste from the consolidation tanks and solidified with the polyacrylate/polyacrylamide material. However, these tanks will contain up to 80 % by volume solidified waste with the remaining volume being filled with grout once the tanks are in place within the landfill. Since these tanks will contain a higher percentage of solidified waste, two additional engineering analyses were conducted to analyze the potential for landfill subsidence associated with the V-Tanks. These analyses examined the corrosion resistance and mechanical strength of the V-Tank shells.

It is concluded that the structural integrity of the V-Tanks themselves is sufficient to minimize settling and subsidence per the requirements of the ICDF landfill because:

1. The corrosion resistance of each stainless steel tank, as documented in EDF-5727 titled "Corrosion Evaluation for Stainless Steel V-Tanks", indicates that the tanks will maintain structural integrity for more than 10,000 years;³
2. The structural integrity of the V-tanks documented above is sufficient to support the 30 ft burial earth column (even when empty) as documented in EDF-5595 titled "TSF-09/18 V-Tanks Remediation Tank Lift Lug Design".⁴ : and
3. The supporting grout placed around the bottom of the tanks will provide the compaction requirements needed to prevent tank settling..

References:

1. DOE/ID-10865, Revision 8, Waste Acceptance Criteria for ICDF Landfill, February 2005.
2. EDF-ER-267 Craig Burger & Montgomery Watson, *Landfill Compaction/Subsidence Study*, May 14, 2002.
3. EDF-5727, Brad Norby, *Corrosion Evaluation for Stainless Steel V-Tanks*, April 2005.
4. EDF-5595, Pat Bragassa, *TSF-09/18 V-Tanks Remediation Tank Lift Lug Design*, April 2005.